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FINAL SCIENTIFIC REPORT

INSTITUTION: The Johns Hopkins University, Department of Mechanics and Material Sciences, Baltimore, Maryland 21218.

PRINCIPAL INVESTIGATOR: Leslie S. G. Kovasznay, Professor of Aeronautics.

GRANT: AFOSR 78-3610

TITLE: Complex Turbulent Flows

REPORT PERIOD: May 1, 1978 - February 28, 1979

(1) GENERAL BACKGROUND

The Grant was awarded for a full year period (May 1, 1978 - April 30, 1979) with a reasonable expectation for continuation up to a 2-3 year period. At the end of the 1978 calendar year, the Principal Investigator left the Johns Hopkins University for the University of Houston. The research activity was hoped to be continued until the end of the grant but when this was proven to be administratively not feasible, the Grant was terminated. Meantime Professor Leslie S. G. Kovasznay established himself at the University of Houston and submitted a research proposal to AFOSR for the continuation of the research that he was beginning at Hopkins under the present Grant.

(2) EXPERIMENTAL FACILITIES

The jet facility was built, new nozzles were fabricated and the basic flow field was checked out.

Hot-wire anemometer circuits were assembled and calibrated. Both constant temperature (CTA) and constant current (CCA) type anemometers were constructed and/or reconditioned.

Interfacing of the electronic instrumentation with the existing minicomputer was achieved on a temporary basis and sample measurements were carried out.

Upon the departure of the Principal Investigator a large portion of the equipment used was dismantled and transported to the University of Houston for the continuation of the research there.

(3) EXPERIMENTAL RESULTS

In order to verify the gradual evolution of the large scale structures in the turbulent jet as they progress from nearly axisymmetric vortex rings into several large, random and truly three-dimensional "lumps" two-point velocity correlations were measured with the two points separated in the azimuthal direction. Measurements were made in the range of $x/D = 0.5 - 40$.

Preliminary measurements were made on a smaller heated "model jet" in order to determine the detailed requirements for the full scale heated jet.

(4) THEORETICAL WORK

During the first few months of the report period Dr. R. Takaki was participating in the research. With his help theoretical work was carried out aimed toward the understanding of turbulent-non turbulent interfaces. Model equation calculations were carried out based on the Nee-Kovasznay "one equation" method (Nee & Kovasznay, 1969, Phys. Fluids, Vol. 12, p. 473). Several configurations were explored: e.g. the growth of a turbulent region in a laminar

Couette flow; the turbulent Rayleigh problem etc. After Dr. Takaki's return to Tokyo the collaboration continued through correspondance.

(5) PUBLICATIONS DURING THE PERIOD BY PERSONNEL SUPPORTED BY GRANT

Leslie S. G. Kovasznay

"Role of the Large Scale Structures in Turbulent Shear Flows - A Question or an Answer?" Lecture Notes in Physics, Vol. 75, pp. 1-18, Springer Verlag, Berlin-New York, (1978).

"Role of the Large Scale Coherent Structures in Turbulent Shear Flows," Turbulence Symposium, Rolla, Missouri, (1978).

"Recent Development in Turbulent Boundary Layers," (in Japanese: RANRYU KYOKAISO NO SAIKIN NO WADAI KARA) Proceedings of the Japan Society of Civil Engineers, Tokyo, Vol. 63, No. 10, p. 56, (1978).

"Combustion in Turbulent Puffs," (with K. Oshima) Nensho Kenkyu (Combustion Research), Vol. 47, pp. 1-18, (1978).

K. R. Sreenivasan

"Local Isotropy of Small Scale Temperature Fluctuations," Proc. 6th International Heat Transfer Conference, Toronto, Canada, pp. 359-364, (1978), (with R. A. Antonia).